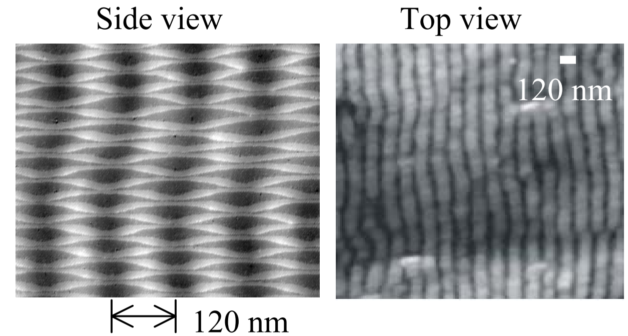
# Effect of Strain on the Self-Assembling of InAs Nanowire Arrays in InAs/GaSb Superlattices

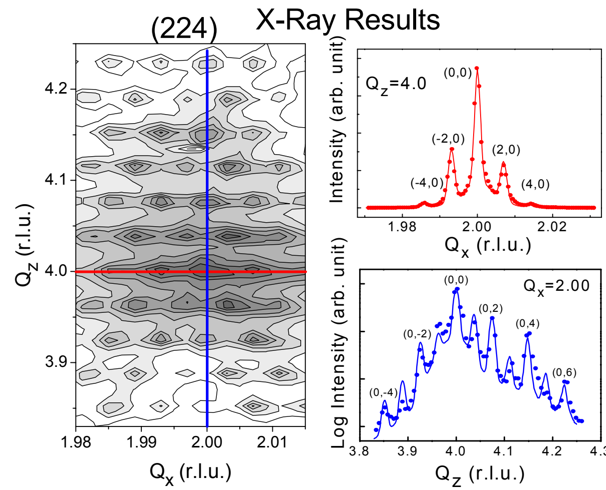
S.C. Moss, Univ. of Houston, DMR- 0408539

Nano-wire or nano-dot arrays based on InAs/GaSb are very promising for the next generation of high performance infrared photo detectors for military, astrophysical and related applications. Our research is focused on 1) what drives the self-assembling process? 2) how can we control the process to improve the nanoscale structures? Here we present results from synchrotron x-ray analysis which show that the interplay between the small strain in InAs and the large strain at the interfaces due to new chemical bonding plays a vital role in the formation of the nanowire array.

Submitted to Physical Review Letters




A two dimensional InAs nanowire array imaged at NRL by scanning probe microscopy




X-ray data and theoretical simulations. These reveal that the strain in the InAs nanowires has been reversed from tensile to compressive due to Sb-incorporation in InAs.

It has become increasingly important to develop nanoscale quantum optoelectronic devices in order to overcome some of the limitations imposed by conventional bulk and multilayer materials. The problems can be eliminated, however, if electrons in the photoactive region are confined in one or both lateral directions, in addition to the usual vertical confinement of a normal multilayer. Such a confinement can be realized by quantum wires QWR or quantum dots QD in place of the usual quantum well structure. Our work is directed toward the mechanism of self-assembly of these new structures and their examination using high-resolution synchrotron x-ray radiation at a national center together with the qualitative examination by cross-sectional TEM and STM. A strength of the program lies in the combination of both computational work and our experiments. We have determined quantitatively the strain distribution in these QWRs which is the driving force for the self-organized structure.

# Effect of Strain on the Self-Assembling of InAs Nanowire Arrays in InAs/GaSb Superlattices

**S.C. Moss, Univ. of Houston, DMR-0408539**

**Education:**

Two graduate students (Santosha Ammu and Ondrej Caha) are contributing to this work. Santosha Ammu is a major in Electrical Engineering and Computer Science and is working for her M.S. Ondrej Caha is a joint Ph.D. physics student between UH and Masaryk Univ. of Czech Republic.

**Collaboration:**

- Dr. Jianhua Li, currently a Research Associate Professor at UH.
- Prof. Vacalv Holy, a leading scientist in the theory of x-ray scattering from nanoscale materials, in particular semiconductors. He is Professor both in Prague and in Brno.

**Societal Impact:**

Infrared (IR) photo detectors based on nanoscale InAs/GaSb nanowires have the capability to cover mid-wave (4~5 μm) to very long wave (>20 μm) spectra with improved sensitivity and response time. They will certainly perform better than the current HgCdTe detectors for both civilian and military purposes and they are tunable in their response.